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Climate change awareness and its determinants in a growing city in the southwestern Nigeria using Multivariate Analysis

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ABSTRACT: Adequate knowledge of climate change scenario is essential to the success of its global remediation efforts. Thus, a study was conducted to investigate into the level of awareness of change in climate in a growing town of Iwo, Osun State, Nigeria. Data for the investigation was generated through the administration of 150 questionnaires across randomly selected adult inhabitants. Of the entire questionnaire, 123 were returned while the rest were either mutilated or returned uncompleted. Descriptive and inferential statistical analyses were conducted. Descriptive analysis showed that 74% of the respondents had no knowledge of change in climate while 21.1% claimed knowledge of it. All respondents that claimed knowledge got the information on television and 76.9% got it on radio. Also, 95.9% of those who had knowledge believed that the solution to climate change associated risks should be borne by international bodies because the menace is global while 86.1% believed it is the responsibility of the Central Government. Factor analysis results showed that four factors predict awareness of change in climate bordering on availability and dissemination of issues associated with change in climate and perception about who tackles the control of the impact of change in climate. It is recommended that information on climate change should be made available and be widely disseminated, especially its impacts and that international communities in conjunction with the national government should take charge of the control and of the associated risks. Further investigation is required to assess the strategies for coping and adapting to the effects of change in climate in the area being studied.

I. INTRODUCTION

United Nations Framework Convention on Climate Change (UNFCCC) (1992) defined climate change as a change which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural climate variability observed over comparable time periods. UNFCC further lamented that change in climate is one of the most serious environmental and human threats in the 21st century undermining the achievement of the Millennium Development Goals (MDGs) and the international communities' efforts to reduce extreme poverty. In its own view, Intergovernmental Panel on Climate Change (IPCC) (2007) defines climate change as a change in the state of climate that can be identified, (possibly through statistical analysis) by changes in the mean and/or the variability of its properties, and that persists for an extended period typically decades or longer. Although, the length of time it takes the changes to manifest matters, the level of deviation from the normal and its impacts on the ecology are most paramount (Odjugo, 2010). Thus secular variation in climate often experienced between 100 and 150 years may not be adjudged to be climate change if such conditions will quickly reverse later evidence of permanent impacts on the ecosystem may be classified as climate change (see also, Ayoade, 2003).

Olorunfemi *et al* (2009) remarked that in view of its geography, climate, vegetation, soils, economic structure, population and settlement, energy demands and agricultural activities, Nigeria has become susceptible to the effects of change in climate. This fact was equally corroborated by Nwafor (2007) when he noted that the biting effects of change in climate will be felt more in underdeveloped nations, especially in Africa due to their low level of coping capabilities.

Furthermore, Odjugo and Ikhuoria (2003), also Ayuba *et al* (2007) noted that researchers have revealed that Nigeria is already being plagued with diverse ecological problems which have been directly linked to the on-going climate change. Investigations have revealed that temperature in Nigeria is on the increase. For in instance, Odjugo (2010) stated that the mean air temperature in Nigeria between 1901 and 2005 was 26.6^{o}C while the temperature increase for the 105 years was 1.1^{o}C which was higher than the global mean temperature increase of 0.74^{o}C recorded since 1860 when actual scientific temperature measurement stared (IPCC, 2007). Thus Odjugo (2010) warned that if this trend continues without being checked, Nigeria, by 2100, may experience as high as 4.5^{o}C risk temperature increase.

In the same vein, rainfall in Nigeria between 1901 and 2005 was reportedly found to be declining. This is, however, contrary to the findings of Ogunbode and Ifabiyi (2019) where it was found that between 1970 and 2007, the rainfall trends in Oyo State has been slightly on the increase. Also, Odjugo (2005) discovered that coastal areas of Nigeria are experiencing slightly increasing trend in rainfall. These scenarios are clear evidence of climate change.

Having, established the reality of climate change in Nigeria, from the global perspective, it has become important to investigate into the level of awareness of climate change among the inhabitants in the township of Iwo in Osun State, Nigeria in view of its associated risks. The investigation is expedient to determine the perception of local people on the change since there are other concepts which could be misunderstood to be climate change- these are climate variability and climatic fluctuation. Research as this at local level will reveal various anthropogenic activities which could have contributed to the incidence of change in climate. Even though, climate change is a global phenomenon, the consequences should be more feasible and obvious at the local scale. Thus efforts to mitigate the effects of change in climate at local level could translate to feasible composite effects at global scale. This research was carried out in Iwo local government area of Osun State, Nigeria between February and May of 2019.

The Concept of Climate Change Situation Awareness and its evidences

One of the priorities of scholars and other climate change-related disciplines is the awareness of the phenomenon. This is at least to ensure the efficiency of various ameliorative measures from different quarters. The situation awareness (SA), according to Endsley (1995b, 1988), is defined as the perception of environmental elements and events with respect to time and space, the comprehension of their meaning and the projection of their future status. Leadership and Workers Engagement Forum (undated) in its own view, described SA as 'being aware of what is happening around one in terms of where one is, where one is supposed to be and whether anyone or anything around one is a threat to one's health and safety'. Thus, one could infer from this description that SA entails comprehension of the happenings around one and to determine whether it is a threat to one's existence or not. Situation awareness has been recognized as a critical, yet often elusive foundation for successful decision-making across a broad range of situations, including the prevailing global warming (climate change). The relevance of a situational awareness in climate change amelioration cannot be overemphasized in view of human dynamism in environmental management. Endsley (1995c) noted that SA enables relevant agencies organizations, industries, government at different levels and individuals to assess the situation and decide what efforts need to be put in place for subduing the resultant consequences. In view of the high level of illiteracy ravaging developing nations especially in the sub-Saharan Africa, several actions need to be considered to realize true comprehension of the scenario. For instance, Lee *et al* (2015), in his investigation, discovered predictors of climate change awareness in Latin America and Europe is the understanding of anthropogenic factors while in many African and Asian countries, perception of local temperature change is the strongest predictor. Thus these authors concluded that improvement in basic education, climate education and public understanding of the local dimensions of climate change are vital to

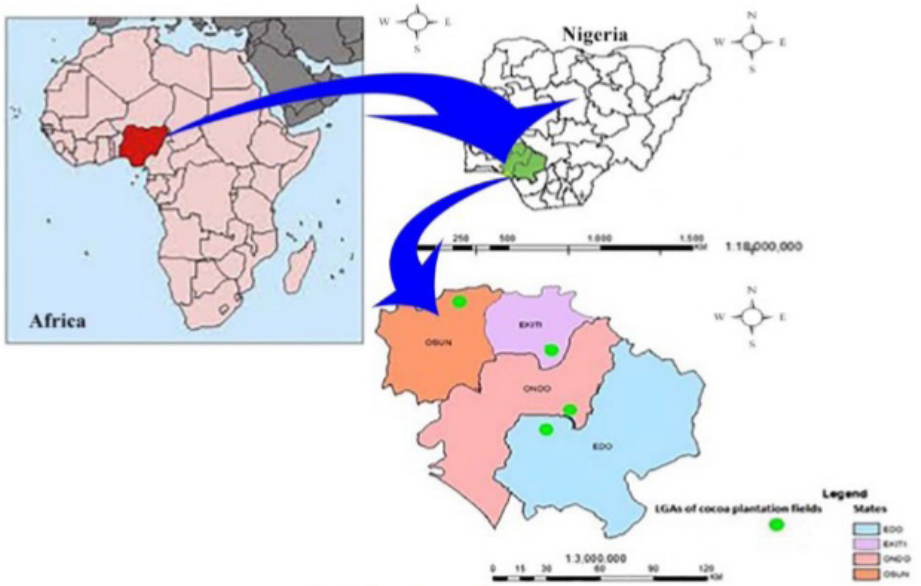

Fig. 1: Locations of the study area

Fig 1: Location of the study area

public engagement and support for climate action. Furthermore, Lee *et al* (2015) discovered various indices that predict climate change awareness in various countries in the world. For instance, they found that education level predicts in 70 countries (62% of the entire countries studied) and also, beliefs about climate change in 37 countries (48%) as top ranked predictors of climate change awareness.

However, in Nigeria, the findings of Onyekuru and Marchant (2017) corroborated the view of Lee *et al* (2015) on the significance of the influence of education level in the perception of climate change. In addition to this, Onyekuru and Marchant found that level of income also inhibits people's perception of climate change in Nigeria because those that are well to do are less likely to perceive climate change as they are less dependent on forest resources than those that are not.

Climate change awareness is significant is any meaningful ameliorative measures would be realized in view of its consequence in the environment. United Nations Framework Convention on Climate Change (UNFCCC) (1992) had revealed that climate change is one of the most serious environmental and human threats undermining the achievement of the Millennium Goals (MDGs) and the international communities' efforts to reduce poverty. Despite its relevance, the level of awareness of the scenario of climate change, the proportion of those that understood the challenges posed by climate change is still low especially in developing nations, Nigeria inclusive. It is in this light of this situation thatt this work investigated into the level of awareness of climate change, adaptation and coping strategies in a growing city of Iwo in the southwestern Nigeria. Specific objectives are to: (1) determine the level of awareness of change in climate in Iwo; and (2) to investigate those factors that determine the awareness of climate change in the study area, and (3)to highlight adaptation and coping strategies to climate change in the study area.

II. MATERIALS AND METHODS

Iwo township and the headquarters of Iwo Local Government Area (Fig. 1), located in Osun State in the southwestern Nigeria, has an area of 245km^2 with a population of 191,348 according to 2006 population census. It is located on the coordinate axis of 7^{0}38'N and 4^{0}11'E. The prevailing climatic condition is tropical with rainy season spanning through eight months annually, from March to October and the dry season from November to February. Ogunbode (2015) discovered that annual rainfall in most tropical wet climate regions ranges between 1000mm and 2000mm with double maxima in July and September. Iwo habitants are predominantly farmers with high dependence on rainfall for agricultural practices. The township of Iwo is currently witnessing a steady growth and expansion as a result of increase in the population associated with the advent of Bowen University and the Odo-Ori Market which often attract buyers and sellers from various surrounding rural areas and urban centres such as Ibadan, Osogbo, Ikire, Gbongan, Oyo among others. Many of these people are settling in the town, thus there is incursion into the periphery forests for building projects. Religious institutions are also involved in this urbanization process through erection of their worship places. Also crucial to the environmental changes in Iwo is the growth process in Bowen University which has to remove preexisting forest for development purposes, the process, which is likely to continue in the next decades with the expansion of the University. All these developmental projects inflict on the environment and could have enormous effects on the environmental conditions of the town.

Data sources and analysis

The data used in this study were generated through questionnaire survey. One hundred and fifty (150) copies of questionnaire were administered to obtain information on the level of awareness of change in climate among the respondents. Both descriptive and inferential statistics were used in the analysis of the

data. The questionnaire were randomly administered but selective as farmers, technicians, married women, drivers resident in the study area were focused in the administration. Data tabulation and frequency distribution were carried out while factor analysis was done to ascertain what determines the awareness of change in climate among the inhabitants of Iwo.

III. RESULTS AND DISCUSSION

Gender Distribution of Respondents

Table 1 shows the distribution of respondents by their genders. The report reveals that out of 123, 56 or 45.5% of the total respondents were females while 67(54.5%) were males. The results reflect the focus of the questionnaire to ensure male respondents are more included in the survey. This is in view of the fact belief and experience that men in the study area show more interests in the working of nature (being farmers among other climate-dependent practices) than females who are more confined in their homes for domestic chores. Also the male respondents are accessible in the study area than their female partners because of the religious belief of keeping women in purdah.

Educational level distribution of respondents

Table 2 reveals the distribution of the respondents by their respective levels of education. While 56 (45.5%) of the respondents have no formal education. 18(14.6%) have primary education, 31 (25.2%) passed through secondary education and 18 (14.6%) have post-secondary education which includes those that have NCE, OND, HND and University degree certificates. The results generally showed that those with at least primary education (54.3%) were of higher proportion than those without education (45.5%). In view of the structure of the questionnaire, attempts were made to reach out to those with formal education in the survey for ease of reading and interpreting the questions and its completion by themselves.

Distribution of the respondents by their respective occupation

The distribution of the respondents by their various occupation as shown in Table 3 reveals that Farmers had more representative in the survey than any of the other occupations with 42 (34.1%). Other categories include Traders with 25 (20.3%), Drivers with 13 (10.6%), teachers all levels together, 29 (23.6%), medical personnel, 4 (3.3%) while 10 (8.1%) did not indicate their respective occupations in the questionnaire. The high proportion of farmers in the survey was encouraged because farming activities is climate-dependent. The farmers are interested in the daily weather conditions such as rainfall, temperature among others. Thus, it is believed that the awareness on climate change will be

Table 1: Gender Distribution of Respondents

Gender	Total interviewed	Percentage (%)	Cumulative (%)
Female	56	45.5	45.5
Male	67	54.5	100
Total	123	100	100

Table 2: Educational level Distribution of Respondents

Level of education	No	Percentage (%)	Cumulative (%)
No formal education	56	45.5	45.5
Primary	18	14.6	60.1
Secondary	31	25.2	85.3
Post-secondary	18	14.6	100.0
Total	123	100.0	100.0

more pronounced among the farmers than in any other profession. The proportion of those respondents that failed to indicate their respective profession could be due to omission, shyness of disclosing their occupation, e.g. the *okada riders* (motorcycle riders for commercial purposes), those involved in collecting recycle-able items from dump sites, *'alaarus'* (carriers of loads in the market places) among others.

Respondents' awareness of climate change scenario

Table 4 reveals the proportion of the respondents that responded to the question on the awareness of the scenario of climate change. The survey showed that 26 (21.1%) of the entire respondents claimed having knowledge of the scenario while 65 (52.9%) claimed no knowledge of climate change. However, 32 (26.0%) of the respondents did not respond to the question on the awareness of change in climate. The field work revealed that most of the respondents attributed the increase in temperatures and late rains to the work of nature which anyone cannot predict. At times, the claims of the work of nature as the determinant of weather condition were supported with climate-related history over the past years, especially, rainfall pattern. Apart from this, some respondents expressed their belief in the local power to avoid rainfall at any point in time and place (i. e. *the power to push rainfall from one to the other*) whenever there is rain-producing cloud.it is clear from the Table that 97 (78.9%) of the 123 respondents could be categorized as those having no knowledge of climate change or global warming scenario while 26 (21.1%) only claimed having knowledge.

Respondents' claim sources of information about change in climate

The data presented in Table 5 shows the media which those who had the knowledge of climate change scenario claimed got information about change in climate. It is imperative to observe that the response of only those who claimed having the knowledge of climate change in Table 4 were observed here even though the other category responded to the question but were jettisoned since they claimed no knowledge of the scenario. The report in the Table showed that television as the source of information to the 26

Table 3: Occupational Distribution of Respondents

Occupation	No Interviewed	Interviewed (%)	Cumulative (%)
Farming	42	34.1	34.1
Trading	25	20.3	54.4
Driving	13	10.6	65.0
Teaching	29	23.6	88.6
Medical Personnel	04	3.3	91.9
Not indicated	10	8.1	100.0
Total	123	100%	100.0

Table 4: Respondents' knowledge of climate change scenario

Response	No of response	% no of Response	% Cumulative
Having knowledge	26	21.1	21.1
Not having knowledge	65	52.9	74.0
No response	32	26.0	100.0
Total	123	100.0	100.0

(100%) respondents that are aware of the change in climate. Radio serves as he source of information to 20 (76.9%), Newspapers to 12 (46.2%), academic journals to 2 (7.7%), Internet, public library/lectures and government agencies provided information on climate change to 15 (57.7%), 11 (42.3%) and 13 (50%) respectively. However, 2 (7.7%) of the respondents claimed other sources which could be from any other sources not listed here such as Short messages on mobile phones, advertisement flyers, posters among others. The results here implied that television and radio form the closest source of information on matters about change in climate to the respondents and so should be adopted by any agency on climate change awareness for disseminating information on the scenario. Also, other sources such as government agencies, newspapers, internet, public library/lectures should also be adopted as others previously listed. Climate change/ global warming issue affects the whole globe and remediation efforts implies for all and so, it needs to be brought to everyone. The consequence of finding is that no source of information should be relegated but should be fully utilized so that the awareness should be in total. Such sources include academic journals, friends/family and religious institutions with 2 (7.7%), 4 (15.4%) and 3 (11.5%) respectively which are less utilized by respondents in this survey. The other sources also should be identified and utilized to disseminate information on climate change for wider coverage.

Respondents' view on responsibility for tackling climate change challenge

The survey also revealed the views of the respondents on whose responsibility is the tackling of climate change challenge as presented in Table 6. The report showed that most respondents, 34 (27.6%) believed that the tackling of the problem of climate change is the responsibility of the Central Government while 28 (22.8%) believed it is the responsibility of the industries. Other responses showed that 19 (15.4%), 15 (12.2%), 12 (9.8%) and 10 (8.1%) of the respondents respectively claimed that individual citizens, State Government, International Agencies and Local Government should be responsible for the tackling of climate change challenge. The others that the respondents 5 (4.1%) claimed should be responsible for the solution to climate change could include research institutions, professional bodies and so on. Generally speaking, the survey showed that 59 (47.9%) of the respondents are of the opinion that the tackling of climate change scenario is the responsibility of the government all together.

Determinants of awareness of change in climate by factor analysis

The data generated from the survey were subjected to factor analysis. The results as presented in Table 7 shows that four components were extracted from the variables with Eigen values of <=1. These variables

Table 5: Respondents' claimed sources of information on Climate Change

Information Source	No. of response	No. of response (%)
Radio	20	76.9
Television	26	100
Newspapers	12	46.2
Academic Journals	02	7.7
Internet	15	57.7
Public Library/lectures	11	42.3
Government Agencies	13	50.0
Friends/Family	04	15.4
Church/Mosque	03	11.5
Others	02	7.7
Total Respondents Analyzed	26	100.0

Table 6: Respondents' claim for responsibility of tackling Climate change challenge

Options	No of response	No. of Response (%)	Cumulative (%)
Individual citizen	19	15.4	15.4
Industries	28	22.8	38.2
Local Government	10	8.1	46.3
State Government	15	12.2	58.5
Central Government	34	27.6	86.1
International Bodies	12	9.8	95.9
Others	05	4.1	100.0
Total	123	100.0	100.0

are the source of information on climate change-related issues, the personal perception on tackling climate change, availability of climate change-related information and individual perception of the effects of change in climate with variance of 28.0%, 26.1%, 15.1% and 9.9% respectively as presented in Table 8. Thus in all, the four variables extracted alone explain 79.1% explained the variance of the parameters that predict the climate change awareness of the respondents in the study area.

Dissemination of Information on Climate Change-Related Issues

Table 8 shows the component matrix with the variable coded STR (dissemination of climate change-related information) carrying the highest percentage loading of 93.7. The implication of this result is that the ability of relevant agencies and institutions to pass across news and views relating to change in climate has power to determine the awareness of the respondents about change in climate. Makau *et al* (2018) and Sulistyawati *et al* (2018) corroborated this

Table 7: Total Variance Explained as generated by SPSS package

Component	Initial Eigen values			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)
1	8.733	54.584	54.584	8.733	54.584	54.584	4.480	28.003	28.003
2	1.614	10.087	64.671	1.614	10.087	64.671	4.170	26.061	54.064
3	1.297	8.107	72.778	1.297	8.107	72.778	2.419	15.122	69.186
4	1.015	6.346	79.123	1.015	6.346	79.123	1.590	9.938	79.123
5	0.861	5.381	84.504						
6	0.583	3.645	88.149						
7	0.479	2.995	91.144						
8	0.364	2.278	93.422						
9	0.306	1.910	95.332						
10	0.237	1.479	96.812						
11	0.184	1.147	97.959						
12	0.136	0.850	98.809						
13	0.097	0.607	99.416						
14	0.060	0.376	99.792						
15	0.033	0.208	100.000						
16	1.336E-16	8.350E-16	100.000						

finding when it was revealed that information dissemination on related issues is very crucial to the determination of climate change awareness for a valuable investment in associated disaster risk reduction. Similarly, Menny *et al*, Shi *et al*, and also, Agboola and Micheal in 2011, 2015 and 2016 respectively, revealed that cultural world views and knowledge about climate were significantly related with people's concern about the scenario of change in climate. Thus, it is pertinent to conclude here that dissemination of information on climate change should be pursued vigorously in the study area to create awareness. Doing this, hopefully, could help to avert the risks associated with the scenario in the study area.

Perception on Tackling Climate Change

Component matrix of the climate change variables as presented in Table 8 showed that individual perception of whoever is responsible for tackling climate change has power to predict the awareness of climate change by 61.1 percent loading, which also forms the second variable on the matrix. The results implies that the body that takes up the challenge of remedying climate change be it government, international agencies, industries, professional groups and individuals determines people's awareness of the scenario. In a similar investigation, Spence *et al* (2011) noted that the view of "I can personally help to reduce climate change by changing my behavior" was found to be a strong determinant of readiness to undertake measures that are energy-saving while Butler and Pidgeon (2011) also observed that where respondents perceived themselves to be 'powerless' in tackling climate-change-related risks adversely influence climate change awareness. In most developing, Nigeria inclusive, and developed nations as also noted by Taylor *et al* (2014) and Shahid and Piracha (2016), the general perception is that public institutions are better positioned to tackle problems such as climate change challenges strongly predicts the awareness of people on this scenario. Thus the willingness and readiness of public institutions to take the responsibility of tackling climate change strongly influences the awareness of climate change.

Availability of Climate Change-Related Information

Factor analysis further revealed that knowledge of change in climate among the respondents is also influenced by availability of information related to the phenomenon of change in climate. Table 8 shows that the component has a loading of 40.2 percent, which is the highest of all other variables. The availability of such information affords the respondents the ability to hear about the scenario. Thus, for this variable to be efficient in predicting the awareness of people, then it must be expressed in the language understood by the people and through all medium available within that coverage. When people hear about climate change in the language well understood, it could empower them to think and build positive response in them on the phenomenon. Ojudgo (2013), in his investigation, found that his respondents in both rural and urban areas do not know anything about climate change and so recommended that climate change education and campaign should be vigorously pursued to enhance the availability of information in the area. On the contrary, Agboola and Emmanuel (2016) revealed that their respondents who were students are well informed of climate change, the discovery they attributed to their closeness to information among others. Thus, as Nzeadibe (2011) and Shahid and Piracha (2016) also confirmed, it is expedient that relevant stakeholders should endeavor to ensure every impediment to information dissemination should be subdued and that people should be fed with such news in a simple and unambiguous language as this will enhance their participation in the efficacy of ameliorative measures.

Perception on The Effects of Change in Climate

The results of the analysis as presented in Table 8 shows that individual perception of what the effects of change in climate are is a strong predictor of the awareness of climate in the study area. While some respondents perceive that the effect of climate change is increased heat in the environment, some felt it is its influence on crop yields, for some, it is health challenges. It is expected that whatever the perception of individual is on what impact climate change poses dictates their level of awareness. Shi et al (2015)'s finding was in support of this discovery when it was noted that the knowledge of the causes of the change in climate significantly increased individual's concern about change in climate and their willingness to support climate friendly policies and so recommended that climate change risk communication should focus on the knowledge of the causes of the change in climate. Also in corroborating this view, Ricart et al (2018) noted the power of public perception on the effects of change in climate among their farmer respondents in determining awareness of the phenomenon at European level.

IV. CONCLUSION

In an attempt to avert the risks that are related to change in climate, awareness of the reality of the phenomenon is crucial so that all remediation measures to checkmate the associated risks could be effective. Thus a survey was conducted to assess the level of awareness among the inhabitants of Iwo in Osun State, Nigeria. Descriptive analysis showed that 21.1% of the entire respondents claimed awareness of climate change while 74.0% were not aware of the phenomenon. Also, of all that claimed aware of the scenario of climate change, 76.9% claimed gotten information on climate change from radio stations while all respondents got the information on television stations, Other sources of information such as internet shuffling, newspapers and campaign by the Central Government also served as sources of information related to the phenomenon of change in climate. Apart from this, 86.1% of the respondents claimed that the responsibility of tackling climate change challenges should be borne by the Central Administration while 95.9% believed that international organizations should

Table 8: Component Matrix

	Component			
Component	1	2	3	4
KCC	0.800	0.069	0.378	0.251
FCC	0.887	0.174	0.325	-0.161
RCC	0.887	0.174	0.325	-0.161
HCC	0.726	0.088	0.402	-0.198
WtCC	0.759	0.197	0.362	-0.146
WhCC	0.871	0.023	0.264	0.084
STR0	0.937	0.046	-0.213	-0.046
ICTY	0.864	0.080	-0.075	0.350
ReCC	0.855	0.058	-0.271	0.238
CCC	0.885	0.059	-0.371	-0.034
ImCC	0.723	0.354	0.371	0.031
PcCC	0.402	-0.484	-0.216	-0.195
EfCC	0.401	-0.412	0.206	0.708
TkCC	0.068	0.611	-0.271	0.104
RpCC	0.516	-0.591	-0.025	-0.163
PsCA	0-.633	0.485	0.133	0.270

take charge of the control of the phenomenon probably for the fact that the scenario of change in climate is global. However, the results of factor analysis revealed that four factors strongly predict the awareness of the respondents in the study area. These are dissemination of information on climate change-related issues, perception on tackling climate change, availability of climate change-related information and, perception on the effects of climate change. While availability and dissemination of information strongly determines the awareness of climate change, so also attitudes to its effect and who takes charge of tackling it are predictors of the awareness. It is therefore recommended that effort should be made to ensure availability of information and its dissemination to ensure public awareness of climate change. Also, stakeholders such as United Nations and its agencies should be in the fore front of tackling the menace in conjunction with the Central Government of the country.

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